HIGH-PERFORMANCE INTERNAL COMBUSTION ENGINE WITH IMPROVED HANDLING OF EMISSION AND METHOD OF CONTROLLING SUCH ENGINE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This Patent Application claims priority from Italian Patent Application No. 10201800004821 filed on Apr. 24, 2018, the entire disclosure of which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The present invention concerns an internal combustion engine for a motor-vehicle, with direct fuel injection, in particular a high-performance internal combustion engine for a GT motor-vehicle, with improved handling of emissions.

[0003] The present invention furthermore concerns a method for controlling the above-mentioned internal combustion engine.

PRIOR ART

[0004] High-performance internal combustion engines for automotive use are known comprising a plurality of cylinders, for example six, eight, ten or twelve, split into two banks which form an angle ranging from 60° to 180° between each other.

[0005] The known engines further comprise an intake manifold for each bank, fed with fresh air (combustion agent for the combustion) and in turn connected to the cylinders of the bank by means of respective intake ducts.

[0006] Analogously to the intake, the cylinders of each bank are connected to a relative exhaust manifold by means of respective exhaust ducts having the function of expelling the combustion products. Each exhaust manifold then conveys the exhaust gases expelled from its cylinder bank towards a catalytic system for the abatement of the polluting engine emissions.

[0007] Each cylinder is further associated with at least one intake valve (normally two twin intake valves) for controlling the airflow entering from the intake manifold and with at least one outlet valve (normally two twin outlet valves) for controlling the outflow of exhaust gases towards the exhaust manifold. Furthermore, each cylinder is associated with an injector to cyclically inject fuel into the cylinder. Each cylinder is coupled with a respective piston, which is adapted to slide in a linear manner along the cylinder and is mechanically connected to a crank shaft by means of a connecting rod.

[0008] If the internal combustion engine operates according to the Otto cycle (i.e. powered by petrol or equivalents), each cylinder is also associated with a spark plug for cyclically determining ignition of the mixture formed by fuel and air present inside the cylinder and triggering the combustion reaction.

[0009] For each cylinder, the corresponding intake valves and part of the corresponding intake duct (comprising the intake manifold) constitute an intake member which has the function of supplying fresh air to the inside of the cylinder.

[0010] Analogously, for each cylinder, the corresponding outlet valves and part of the corresponding exhaust duct (comprising the exhaust manifold) constitute an outlet member which has the function of expelling the exhaust gases from the inside of the cylinder.

[0011] The cylinders of each bank are usually obtained inside a base or monoblock; the intake and outlet members associated with each cylinder are instead carried by a head fixed in abutment on the base at an upper axial end of the cylinders.

[0012] The piston in reciprocating motion inside each cylinder delimits with the latter and with the head a chamber commonly known as combustion chamber, namely the chamber in which ignition of the mixture formed of the fuel and the air takes place.

[0013] Direct injection occurs when the injector feeds the fuel directly into the combustion chamber of the respective cylinder.

[0014] A critical point of the known engines is represented by the heating of the catalytic system. In practice, a catalytic system operates effectively only above a certain temperature value, usually above 300-400° C. Until that moment, abatement of the engine emissions is minimum. This is why a large part of the engine emissions in an emission test cycle are recorded before the catalytic system enters the temperature range necessary for effective operation.

[0015] A catalytic system would heat up quickly only in the case of a high-power requirement by the vehicle driver. At engine start, on the other hand, the power/torque requirement is low.

[0016] To remedy this drawback, strategies have been developed to rapidly heat the catalytic system even without power/torque requirement by the driver.

[0017] The first strategy is to increase the flow rate of the air entering the cylinders at the engine start, consequently obtaining a higher flow rate of the exhaust gases flowing out of each combustion chamber. By doing this only, the engine would produce more torque than that required.

[0018] A second strategy is therefore adopted, the spark plug associated with each cylinder produces, during each engine cycle, a very delayed spark inside the combustion chamber thus reducing the torque produced by the idling engine and heating the exhaust gases; in this case, the combustion occurs late in each cylinder and therefore the expansion phase (movement of the respective piston between the top dead centre and the bottom dead centre resulting from ignition in the respective combustion chamber) between the end of the combustion and opening of the respective outlet valve/s is reduced. A high flow rate of the exhaust gases is therefore obtained, and a high temperature of the latter which rapidly heat the catalytic system to bring it as quickly as possible to conditions of maximum efficiency.

[0019] The problem is that of establishing the entity of the delay in production of the spark, and therefore the beginning of combustion, that can be tolerated by an engine so that the combustion does not become unstable or the air and fuel mixture does not ignite (phenomenon known as misfire).

[0020] To obtain an engine that operates well also with a long spark production delay in each cylinder, the strategy commonly known as spark coupled injection has been developed. With this strategy, a small injection of fuel is made in each cylinder just before production of the spark by the spark plug, thus generating turbulence near the spark plug at the critical moment of ignition of the air-fuel mixture. This allows stabilization of the beginning of the